

Study on the biological characteristics of *Homalotglus flaminus*

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Abstract: *Homalotglus flaminus* (Dalman) is an important natural enemy of the *Chilocorus kuwanae*. Its biological characteristic, life history, the action style on hosts were studied at Hongqi Forest Farm, Daqing City, Heilongjiang Province from June 1998 to October 2000, in order to control *H. flaminus* and raise the control ability of *Chilocorus kuwanae* to *Quadraspidiotus gigas* pest. The observed results indicated that *H. flaminus* has two generation one year in study area, the pupating span is 12.7 d, life span of females and males is 17.6 d and 10.8 d respectively, egg span is 10 d, and the sex ratio of females to males is 1:3.

Keywords: *Homalotglus flaminus*, *Chilocorus kuwanae*, Biological Characteristics

CLC number: S763.43

Document code: A

Article ID: 1007-662X(2001)04-0269-02

Introduction

Homalotglus flaminus (Dalman), the important natural enemy of the *Chilocorus kuwanae*, belongs to homalotglus, encyritidae, and hymenoptera (Ichii 1928). *Quadraspidiotus gigas*, the host of ladybird, is the main insect pest of the poplar forests in the northeast of China. The *Chilocrus kuwanae* take an important part in the natural enemy system of control the *Q. gigas*. The biological characteristic, life history, the action style for hosts *H. flaminus* were studied in this paper from June 1998 to October 2000, in order to control *H. flaminus* and raise the control ability of ladybird to *Q. gigas* pest. The experiment was carried out in 18-hm² plot of pure poplar stand at age of 8, located at Hongqi Forest Farm, Daqing City, Heilongjiang Province. The poplar stand was heavily damaged by *Q. gigas*, and ladybird had a stable population with a high ability to control *Q. gigas* in this stand (Liao 1987, Institute of Zoology of Academy of Science of China 1987).

Biological characteristics

Span of the overwintered pupae

From the last 10 days of October in 1998 to the middle of 10 days of April in 1999, several larvae of ladybird which was black, with branch thorns but without eclosion holes on their backs and parasitized by *H. flaminus* were brought back indoors from the experiment forest and put into thick tubes. The tubes were covered by nylon cloth to prevent the adults of *H. flaminus* from escaping from the tubes. Three ladybirds parasitized by *H. flaminus* were split every two days. The pupating time and eclosion time of *H. flami-*

nus and mean daily temperature were recorded. The results showed that under the mean daily temperature of 16 °C, the pupating span of the overwintering *H. flaminus* is 12-13 d, and 12.46 d on average (see Table 1).

Table 1. The span of pupa of overwintered *H. flaminus*.

No.	Pupating date	Emergence date	Period of time /d	Average temperature (°C)
1-3	3/5	15/6	13	16
4-3	3/5	16/6	12	

The life span of the overwintered adults

Nine adults of *H. flaminus* were put into tubes covered by nylon cloth just after their emergence, and fed with 20% honey water. The experiment showed that the life span of the adults of is 10-25 d, with an average of 17.6 d for females, 10.8 d for males (see Table 2).

Table 2. The life span of overwintered adult of *H. flaminus*

No.	Sex	Emergence date	Death date	Adult life
1	♂	14/5	24/5	10
2	♂	14/5	24/5	10
3	♀	14/5	8/6	25
4	♂	14/5	26/5	11
5	♀	14/5	30/5	15
6	♀	15/5	28/5	13
7	♂	15/5	27/5	12
8	♂	15/5	26/5	11
9	♂	15/5	26/5	11

Sex ratio

The ladybird larvae parasitized by *H. flaminus* were collected from experiment forest in the middle 10 days of the June 1998 and put in thick tubes. A hundred of *H. flaminus* adults were killed by smoke after their emergence, and 23 females and 77 males were checked out, with a sex ratio of 1:3.

Foundation item: This paper was supported by Natural Science and Foundation of Heilongjiang Province.

Biography: MA Ling (1963-), female, Ph. Doctor, associate professor in Northeast Forestry University, Harbin 150040, P. R. China.

Received date: 2001-10-04

Responsible editor: Song Funan

Mating

The female wasps mate immediately after their emergence. When the male wasps find the female ones, they crawl up their backs, then turn down their heads and present mating position in a "1" pattern. They spend several seconds on mating. The number of male wasps is three times of that of female ones. So the female wasps can mate a lot of times during their life, but the male ones mate only one time.

Spawning

After mating, the female wasp crawl in high speed along the tree trunks to search hosts, then it move back to the tip of the young larvae of ladybird, tuning back its body to made the back downwards, the abdomen upwards, the tip of abdomen benching upwards, and ovipositor to be level to inject the body of young larvae of ladybird to spawn. The spawning time lasts tens of seconds. The eggs of laying at one time were determined according to the eclosion holes on the shells of ladybird. In general, there are 1 or 2 eggs in one eclosion hole. One female wasp spawns 19.5 eggs at least, 37.5 eggs at the most, and 25 eggs on average.

Spawning span

Nineteen ladybird larvae parasited by *H. flaminus* at the same day were collected and put in a big glass box. *Q. gigas* was put into the box as food of ladybird. After 4 d, one ladybird larva was split every another day. It was found that the egg span of *H. flaminus* was 9 d under the mean day temperature of 17.5 °C (see Table 3).

Table 3. The period of egg

Amount	Spawning date	Hatched date	Egg span	Average temperature (°C)
3	14/5	23/5	9	17.5
6	15/5	24/5	9	

Larvae span

The *H. flaminus* larvae in the body of ladybird hatched at the same day were put in a big glass box. After 4 d, two larvae of ladybird were split every another day. The mean day temperature and hatched and pupated time of *H. flaminus* larvae were recorded. It was determined that the larvae span of *H. flaminus* was 10 d under the mean day temperature of 20.7 °C (see Table 4).

Table 4. The period of wasp larvae

Amount	Hatched date	Pupated date	Larva span	Average temperature (°C)
10	24/5	3/6	10	20.7

Life history

According to the observation, *H. flaminus* has two generations one year. It overwinters in body of *Chilocorus kuwanae* larvae attached on the trunk of poplar. The wasp

larvae that survived in winters restore to act in the last ten days of April next year, pupate in the shell of young larvae of *Chilocorus kuwanae* in the first ten days of May, and begin to emerge in the middle of ten days of May. The time is short between pupating and emergence. After eclosion, the adults bite a round eclosion hole on the back of the young larvae shell of *Chilocorus kuwanae*, and flies out to mate, then spawns. The time of spawning is very long, lasting from the 15th May to the 6th June. It is very identical the spawning time of female wasp and the occurring time of young larvae of *Chilocorus kuwanae*. The young larvae of wasp swallow fats and flesh of the body of young larvae of *Chilocorus kuwanae*, but they don't damage the important parts of body, so the parasitized larvae could still survive. When the wasp larvae grow up, they swallow up all the tissue of the hosts, only the dull bitch-black shells of the young larvae of ladybird remained and attached on the trunks of trees. The wasp larvae begin to pupate in the shell of the young larvae of ladybird. The pupae are white at beginning, and then turn to black little by little. The pupating time is from the 20th June to the 10th July. The first generation of the wasp adults begin to appear on the 30th June and vanish on the 20th July. They bite the larvae shells of *Chilocorus kuwanae* by the upper jaw and come out. The eclosion holes are remained on the young larvae shells of ladybird.

Location of kairomone

Thirty larvae of ladybird were split and their foreguts, hindguts and shells were grinded and put in extracting liquid. It was found that the extracted materials from the hindguts had an attractive chemical ingredient, which could attract ladybird to pupate together, and attract *H. flaminus* to lay eggs on ladybird. The attractive ingredients were not found in the extracted materials from foreguts and shells.

Conclusions and discussions

H. flaminus has two generation one year. On average, the pupating span is 12.7 d, life span of females and males is 17.6 d and 10.8 d respectively, 25 eggs can be laid, egg span is 10 d and the sex ratio of females to males is 1:3. Kairomone, located on the midgut or hindgut of ladybird, should be analyzed further for use to control of *H. flaminus*, thus using *C. kuwanae* to control *Q. gigas*.

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